

**Remarks**

Claims 2, 4, 6, and 7 are pending herein. Claims 3-6 were withdrawn as being directed to a non-elected invention. Claim 2 has been amended to incorporate the contents of claim 1. New claim 7 has been added.

New claim 7 depends upon claim 2 and recites that the spherical alumina is present in an amount of from 85% to 92% by weight based on the total weight of the resin composition. Support for claim 7 can be found in the specification at, e.g., page 6, lines 7-16.

In the Office Action, claim 1 is rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,506,822 to Ichiroku et al. ("Ichiroku") and Japanese Patent No. 4-132727 ("JP '727") in view of U.S. Patent No. 6,310,120 to Shiobara et al. ("Shiobara '120") and U.S. Patent No. 5,362,775 to Shintai et al. ("Shintai"); claim 1 is rejected under §103(a) as being unpatentable over U.S. Patent No. 5,049,596 to Fujimoto et al. ("Fujimoto") in view of Shiobara '120, Shintai and U.S. Patent No. 6,001,901 to Shiobara et al. ("Shiobara '901"); and claim 2 is rejected under §103(a) as being unpatentable over Fujimoto in view of Shiobara '120 and Shintai as applied to claim 1 hereinabove and further in view of Shiobara '120.

In view of the amendments and remarks herein, Applicant respectfully requests reconsideration and withdrawal of the rejections set forth in the Office Action.

**I. First Rejection of Claim 1**

As noted above, claim 1 was rejected under §103(a) as being unpatentable over Ichiroku and JP '727 in view of Shiobara '120 and Shintai.

According to the Office Action, "[m]ore favorable consideration would be given with respect to this rejection if the limitations of claim 2 were to be incorporated into claim 1 since neither Ichiroku et al. nor Japanese '727 recite the polyorganosiloxane present in an amount of as low as the claimed range of from 0.3-2.0% by weight."

Claim 2 has been amended to include the contents of canceled claim 1. Therefore, claim 2 now recites that the silicone compound (C) is a polyorganosiloxane and is present in an amount of from 0.3 to 2.0% by weight based on the total weight of the resin composition.

As noted above, the Office Action states that neither Ichiroku nor JP '727 teaches the use of a polyorganosiloxane in an amount of from 0.3 to 2.0% by weight based on the total weight of the resin composition. Applicant respectfully submits that the secondary references do not cure this deficiency.

The Office Action notes that Ichiroku teaches a organopolysiloxane oil, which is part of component (D) of the Ichiroku composition. Ichiroku also teaches the use of a silicone-stress reducing agent, i.e., component (C). The only silicone-containing materials disclosed in Shiobara '120 are used for stress reduction (col. 4, lines 45-48). Thus, any teaching in Shiobara '120 regarding the amount of the silicone-containing material therein would not be applicable to the amount of Ichiroku's organopolysiloxane oil component, which is not used for stress reduction.

Shintai does not disclose any amount of a polyorganosiloxane. The reference teaches the use of silicone-modified epoxy or phenol resins in an amount of 5 to 70 parts by weight per 100 parts of the total of the epoxy resin and curing agent (col. 9, lines 63-67). The reference teaches that if "the amount of the silicone modified epoxy resin or phenol resin is less than 5 parts, a sufficient low stress characteristic is difficult to obtain and if over 70 parts, the mechanical strength of the molded product falls in some cases" (col. 9, line 68 – col. 10, line 4). Thus, any teaching in Shintai regarding the amount of the silicone-modified epoxy or phenol resins therein would not be applicable to the amount of Ichiroku's organopolysiloxane oil component, which, as noted above, is not used for stress reduction.

Thus, Ichiroku in view of Shiobara '120 and Shintai does not teach the amount of the polyorganosiloxane recited in claim 2.

JP '727 teaches the use of 5-20 weight percent of silicone oil. The abstract of JP '727 does not state the purpose of the silicone oil. Applicant submits that neither Shiobara '120 nor Shintai provides any motivation, reason or suggestion to use a different amount of silicone oil, particularly 0.3 to 2% by weight, in JP '727. Thus, JP '727 in view of Shiobara '120 and Shintai does not teach the amount of the polyorganosiloxane recited in amended claim 2.

Thus, claim 2 would not have been obvious over Ichiroku and JP '727 in view of Shiobara '120 and Shintai.

New claim 7 depends upon claim 2 and, therefore, is patentable over Ichiroku and JP '727 in view of Shiobara '120 and Shintai for at least the same reason claim 2 is patentable over these references.

## **II. Second Rejection of Claim 1**

Claim 1 also was rejected under §103(a) as being unpatentable over Fujimoto in view of Shiobara '120, Shintai and Shiobara '901. The Office Action states that:

[m]ore favorable consideration would be given regarding this rejection if the limitations of claim 2 were to be inserted into claim 1 because the claimed level of silicone compound as a polyorganosiloxane is not recited.

As noted above, claim 2 has been amended to include the contents of canceled claim 1. Thus, Applicant respectfully submits that amended claim 2, as well as new claim 7 (which depends upon claim 2), would not have been obvious over Fujimoto in view of Shiobara '120, Shintai and Shiobara '901.

## **III. Rejection of Claim 2**

Claim 2 is rejected under §103(a) as being unpatentable over Fujimoto in view of Shiobara '120 and Shintai as applied to claim 1 above, and further in view of Shiobara '120. According to the Office Action:

The references are described hereinabove. Fujimoto et al. does not recite the claimed polyorganosiloxane as the organosilicone compound. It would have been obvious to include from 0 to 20 parts by weight per 100 parts by weight of the epoxy resin and curing agent of the silicone rubber or oil of Shiobara et al. '120 in order to reduce the stress (col. 4, lines 45-48 and col. 5, lines 59-63).

Applicant respectfully submits that amended claim 2 would not have been obvious over Fujimoto in view of Shiobara '120 and Shintai as applied to claim 1, and further in view of Shiobara '120.

As discussed previously herein, Shintai does not disclose any amount of a polyorganosiloxane. The reference teaches the use of silicone-modified epoxy or phenol resins in an amount of 5 to 70 parts by weight per 100 parts of the total of the epoxy resin and curing agent (col. 9, lines 63-67).

Applicant respectfully submits that it would not have been obvious in view of Shiobara '120 to use a polyorganosiloxane in Fujimoto in an amount of from 0.3 to 2.0% by weight based on the total weight of the resin composition, as recited in amended claim 2.

The MPEP<sup>1</sup> cites *In re Woodruff*, 16 USPQ2d 1934 (Fed. Cir. 1990) for the following proposition:

The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.

The instant specification teaches at page 8, line 24 through page 9, line 3 that if the amount of the polyorganosiloxane is less than 0.3%, “the modulus of elasticity cannot be greatly reduced and the effect to reduce warpage becomes smaller, and temperature cycle resistance is also inferior”. If the amount of the polyorganosiloxane is greater than 2.0%, “flowability and curability are deteriorated”.

Thus, the instant specification teaches that the particular amount, specifically from 0.3 to 2.0% by weight, of polyorganosiloxane significantly affects certain properties of an epoxy resin composition. These effects are not taught or suggested in Shiobara '120. One skilled in the art would have to determine such effects on his or her own, with no guidance from Shiobara '120.

Applicant further submits that the particular combination of spherical alumina, ultrafine silica of a specific surface area and concentration, and polyorganosiloxane used in Applicant's claimed composition would not have been obvious over the references cited in the Office Action. The instant specification teaches that:

---

<sup>1</sup> MPEP 2144.05, part III.

According to the present invention, it has been found that an epoxy resin composition for semiconductor encapsulation which has excellent moldability, low molding shrinkage, high resistance to temperature cycle, high soldering crack resistance and high thermal conductivity can be obtained by *using a spherical alumina and a specific ultrafine silica at a specific ratio and further a silicone compound*. [emphasis added] (page 5, lines 3-10).

Thus, the combination of a spherical alumina, an ultrafine silica having a specific surface area of 120-280 m<sup>2</sup>/g and being present in an amount of 0.2-0.8% by weight based on the total weight of the resin composition, and a silicone compound, will provide an epoxy resin composition for semiconductor encapsulation which has excellent properties for area mounting type semiconductor apparatuses, e.g., excellent moldability, low molding shrinkage, high resistance to temperature cycle, high soldering crack resistance, and high thermal conductivity.

The effect of omitting any one of the spherical alumina, the particular ultrafine silica and silicone can be seen in the Examples and Comparative Examples set forth in the specification.

Example 2 and Comparative Example 6 are identical except that Example 2 used spherical alumina and Comparative Example 6 used spherical silica. As can be seen in Tables 1 and 2 (pages 15 and 16), the composition of Comparative Example 6 had significantly lower thermal conductivity (0.9 W/Mk) than did the Example 2 composition (3.5 W/Mk).

Example 2 and Comparative Examples 3 and 4 were identical except that Example 2 used an ultrafine silica having a specific surface area of 180 m<sup>2</sup>/g (i.e., a specific surface area within the range recited in claim 2), whereas Comparative Example 3 used an ultrafine silica having a specific surface area of 100 m<sup>2</sup>/g (i.e., a specific surface area below the range recited in claim 2) and Comparative Example 4 used an ultrafine silica having a specific surface area of 340 m<sup>2</sup>/g (i.e., a specific surface area higher the range recited in claim 2). Example 4 was identical to Example 2 and Comparative Examples 3 and 4 except that Example 4 used an ultrafine silica having a specific surface area of 240 m<sup>2</sup>/g (i.e., a specific surface area within the range recited in claim 2). As can be seen in Tables 1 and 2, the composition of Comparative Example 3 (which used an ultrafine silica having a specific surface area below the range recited in claim 2)

had a significantly longer flash length (2 mm) than did the composition of Example 2 (<1 mm), the composition of Example 4 (<1 mm), and even the composition of Comparative Example 4 (<1 mm). On the other hand, the composition of Comparative Example 4 (which used an ultrafine silica having a specific surface area above the range recited in claim 2) had significantly reduced spiral flow (70 cm), than did the composition of Example 2 (130 cm), the composition of Example 4 (120 cm), and even the composition of Comparative Example 3 (130 cm).

Example 2 and Comparative Examples 1 and 2 were substantially identical except that Example 2 used an ultrafine silica having a specific surface area of  $180 \text{ m}^2/\text{g}$  and present in an amount of 0.5% by weight (i.e., within the weight range recited in claim 2), whereas Comparative Example 1 used an ultrafine silica having a specific surface area of  $180 \text{ m}^2/\text{g}$  and present in an amount of 0.1% by weight (i.e., below the weight range recited in claim 2), and Comparative Example 2 used an ultrafine silica having a specific surface area of  $180 \text{ m}^2/\text{g}$  and present in an amount of 1.0% by weight (i.e., exceeding the weight range recited in claim 2).

As shown in Tables 1 and 2, the composition of Comparative Example 1 (which used an amount of ultrafine silica below the weight range recited in claim 2) had a significantly longer flash length (3 mm) than did the composition of Example 2 (<1 mm) and even the composition of Comparative Example 2 (<1 mm). On the other hand, the composition of Comparative Example 2 (which used an amount of ultrafine silica exceeding the weight range recited in claim 2) had significantly reduced spiral flow (80 cm), than did the composition of Example 2 (130 cm) and even the composition of Comparative Example 1 (130 cm).

Example 2 and Comparative Example 5 were substantially identical except that the Example 2 composition contained polyorganosiloxane, whereas the composition of Comparative Example 5 contained no polyorganosiloxane. As shown in Tables 1 and 2, the composition of Comparative Example 5 had more warpage ( $120 \mu\text{m}$ ) and reduced temperature cycle properties after both 500 cycles and after 1000 cycles (3/10 and 10/10, respectively) than did the Example 2 composition (warpage of  $80 \mu\text{m}$  and temperature cycle properties of 0/10 and 1/10 after 500 and 1000 cycles, respectively).

Thus, the Examples and Comparative Examples show the unexpected benefits associated with the combined use of: (i) spherical alumina rather than spherical silica, (ii) ultrafine silica having a specific surface area within a specified range and being present within a specified weight range, and (iii) a polyorganosiloxane. Such unexpected benefits resulting from the combined use of these ingredients are not taught or suggested in the references cited in the Office Action.

Thus, for at least the foregoing reasons, Applicant respectfully submits that amended claim 2 would not have been obvious over Fujimoto in view of Shiobara '120 and Shintai as applied to claim 1, and further in view of Shiobara '120.

#### **IV. Patentability of New Claim 7**

New claim 7 depends upon claim 2 and recites that the spherical alumina is present in an amount of from 85% to 92% by weight based on the total weight of the resin composition.

According to the instant specification:

The amount of the spherical alumina used in the present invention is preferably 85-92% by weight based on the total weight of the resin composition. If the amount is less than the lower limit, thermal conductivity lowers, and besides the molded product of the area mounting type semiconductor apparatus is warped, which is not preferred. If the amount exceeds the upper limit, thermal conductivity is improved, but flowability is inferior, which is not preferred (page 6, lines 7-16).

Such advantages associated with the use of the specified amount of spherical alumina are not taught or suggested in the references cited in the Office Action.

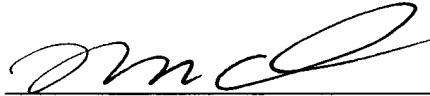
Thus, Applicant respectfully submits that claim 7 is patentable over the references cited in the Office Action.

**V. Conclusion**

In view of the amendments and remarks herein, Applicant respectfully requests that the rejections be withdrawn and that claims 2 and 7 be allowed.

If any fees are due in connection with the filing of this paper, such as fees under 37 C.F.R. §§1.16 or 1.17, please charge the fees to Deposit Account 02-4300; Order No. 033036M073.

Respectfully submitted,  
SMITH, GAMBRELL & RUSSELL, LLP



---

Michael A. Makuch – Registration No. 32,263  
1850 M Street, NW – Suite 800  
Washington, DC 20036  
Tel : 202 263 4300  
Fax : 202 263 4329

Date : November 21, 2006  
MAM/MM/cj